

## Studies of Occupational Cancer

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State health departments are in an especially favorable position to pursue occupational cancer studies, because of their organization and the authority vested in them by law. With few exceptions, State health departments have in their organizations the personnel and facilities essential for such investigations, including the three basic divisions—cancer control, biostatistics, and industrial hygiene—each of which has a special and separate interest in the problem of occupational cancer. The extensive practical experience available from communicable disease studies conducted in the past is an additional advantage to State health departments in the development of effective occupational cancer control programs, since the methodological approaches employed in epidemiological studies of occupational cancers are similar to those used for many years in the study of epidemiology and control of communicable disease.

The official status of State health departments provides them with opportunity to obtain access to, and collect a large variety of, pertinent records on cancer patients. Apart from information on death certificates, records of workmen's compensation boards, and histories of cancer patients kept by physicians, hospitals, cancer registries, industrial medical and employment departments, labor unions, and insurance companies, State health depart-

ments can draw on the facilities of the Federal Bureau of Old-Age and Survivors Insurance. In addition to data on the employment history of all insured individuals and on employers and industries, this bureau has the names and last addresses of all workers employed since 1937 in each State and in all industrial establishments in the United States. In States in which State disability insurance agencies exist, the State health department has an opportunity to obtain occupational data from living cancer patients.

Cancer control funds provided by the National Cancer Institute to the individual States enable State health departments to implement occupational cancer control programs. In addition, important exploratory investigations on occupational cancer may be supported by special cancer control grants.

### Industrial Exposures

State health departments possess information, usually collected by the division of industrial hygiene, on agents handled, products made, and processes used in individual plants. Supplementary data on special aspects of occupational exposures can be obtained when needed because State laws usually authorize representatives of State health departments to enter industrial establishments to study occupational health hazards to the workers employed and environmental industrial health hazards to the population living or working within their waste disposal zone. The study of occupational cancers can be extended through the cooperation of State labor departments to observation of the laws governing working

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conditions, the use of safety devices, and the application and adequacy of accidental and occupational disease legislation in relation to cancer.

From the relatively specific character of the known and suspected occupational carcinogens, it follows that one must expect an uneven distribution of occupational cancer hazards among the various States, depending on the kind of natural resources present and the specific occupational activities and industrial operations carried on in the States. Each State, therefore, is likely to present an occupational cancer pattern of its own, and would do well to develop a study and control program adapted to its special needs and best suited for preventing, containing, counteracting, or eliminating its particular occupational cancer hazards.

### **State-Wide Control**

The primary objectives of occupational cancer surveys are the collection of reliable data on the incidence rates, site, sex, race, age distribution, and nature and types of exposure to exogenous causal factors of cancers occurring among various occupational groups. Only when sufficient basic information on these aspects of occupation cancers and cancer hazards is available, is it feasible to develop and institute rational and effective control measures. Such studies may employ morbidity data, mortality data, or a combination of both, depending upon the type of investigation most suitable for the industrial conditions in a particular State and for the kind of tumors and population groups to be analyzed for the presence of occupational cancers.

These investigations on cancer morbidity and mortality are aimed at ascertaining whether cancers of certain sites tend to occur with unusual frequency in specific geographic areas or among selected industrial groups. To determine the number and to identify the types of exposed employees, as well as the types and intensities of exposures sustained, it is advisable to conduct surveys of industrial establishments and workshops which, according to information available in the State division of industrial hygiene, produce, use, or handle known or suspected occupational carcinogenic

agents or devices. These surveys should be made either before beginning the investigations or supplementary to them.

### **Morbidity Studies**

The use of morbidity data has a fundamental advantage over use of mortality data. In using morbidity data an attempt is made to determine all cases of cancer in the population surveyed regardless of whether the individuals are employed in a specified industry, are retired, living, or dead, or are engaged in other types of work subsequent to employment in a hazardous operation; whether the cancerous disease is present or symptomatically arrested; whether it was the cause of death, disability and retirement, or a passing event unrelated to the state of health at the time of the survey or to the cause of death, if death has occurred.

This method makes it possible to obtain information by which the total actual and organ specific cancer incidence among the total number of effectively exposed individuals can be approximated. By interrogation of living cancer patients, direct or indirect information on the employment history, specific exposures sustained, diseases preceding or accompanying the development of cancers and possibly related to their etiology may be obtained. The morbidity approach is the most suitable one, if occupational cancers with a high rate of cure, such as skin cancers, are to be studied. Since occupational cancers as a rule do not manifest themselves in an acute, epidemic-like fashion, to obtain valid results, it is necessary to analyze cancer incidence figures for a period of not less than 5 years, unless large population groups are surveyed or there is an unusually high frequency of cancers present in a restricted group studied.

### **Mortality Studies**

#### *Health Jurisdiction Records*

Death certificates in the United States have been uniform since 1940, with revisions every 10 years, in accordance with the changes of the Manual of the International Statistical Classification of Diseases, Injuries, and Causes of Death. Although the data recorded on these

documents are not always reliable and sometimes are incomplete, death certificates provide one source of information on which studies of the incidence and the epidemiological patterns of cancer as related to industrial employment and occupation may be based. Death certificates are available on a state-wide basis from the division of vital statistics of the State health departments and on a regional basis at the local county and city health organizations. The data are recorded in "death volumes" in accordance with health jurisdiction—name of deceased, place of death, and date of death—and include information on age, sex, race, occupation, and social security number, in addition to the primary and secondary causes of death. In the production of the annual report of the State health department, the "State sheets" are prepared from information on mechanical punch cards on which essentially all the data on the death certificates are transcribed in coded form. For the coding of occupational and industrial employment data, the classifications of the Bureau of Employment Security, Social Security Administration, published in 1949 as "Dictionary of Occupational Titles," may be used.

Whenever such punch cards are available for an adequate number of years or can be prepared from the death volumes, a rough statistical analysis can readily be made to determine the total number of cancer deaths, the cancer deaths by organs, and their distribution among various geographic regions, occupations, industries, sexes, age groups, and races. Experience has shown that this particular methodological approach, when made on a State-wide basis, is not especially informative if industries are diversified and well distributed throughout the State. On the other hand, promising leads can be obtained by this technique, if the State has relatively well-defined industrial, urban, and rural areas and industries of certain types predominate in some areas but not in others, that is, if there are regions with differing industrial patterns and thus of different potential cancerigenic hazards. Such conditions may be reflected in regional differences in the total number of deaths from, and in the distribution of, cancers among different organs, sexes, ages, races, and occupations.

This methodological approach appears to

have definite limitations when applied on a state-wide basis. The procedure, on the other hand, has been found more practicable for obtaining important leads on occupational cancer hazards when applied to specially selected regions, counties, or cities having either unusual types of industries or one predominating type of industry. Under such conditions it is possible to ascertain whether relatively definite evidence exists suggesting an occupational or environmental cancer hazard related to the activities of the particular industries present.

Whenever statistical analysis of the data on such a regionally restricted survey of cancer incidence based on death certificates demonstrates an excessive frequency of one or several types of cancers among the population group studied, a serious effort should be made to determine the reliability of the data used, that is, a check of the cancer diagnoses and personal medical and occupational histories should be made. Steps might then be taken to establish the validity of the evidence by broadening the study and elaborating upon the observations. The medical, employment, and insurance records of the industries located in the survey area might be investigated for additional information on the incidence of cancers among workers formerly or presently employed in the various operations, to pinpoint the potential carcinogenic operation or operations and to obtain a lead as to the nature of the carcinogenic agent or procedure involved.

Once this goal has been reached for a circumscribed population group or industry, it is rather simple to extend the procedure to other population groups and industries within the State where similar exposures might prevail. A master list of the names, birth dates, and addresses of persons who over a period of years died of cancers involving organs under study is prepared from the death volume. It is submitted to the industrial concerns of the area to be surveyed, with a request to indicate those individuals they had employed, the departments in which—and jobs at which—they worked and the dates of employment in each of these departments. In this manner pertinent information becomes available on exposures formerly sustained by deceased cancer patients while working for different employers. This

evidence then has to be analyzed and weighed for its significance in regard to the type and site of cancer studied.

If the results of such studies in occupational cancer epidemiology and etiology should prove their usefulness to a State health department, the above-described plan may be incorporated among the routine procedures of disease control. Under such a scheme the industrial concerns of the State are circularized at the end of each year with a list containing the names of cancer patients who died during this particular year. The industries are requested to check the names given against their personnel records and to note previous employment with the company and the years and types of employment. In States with cancer registries, this scheme can be applied also on a cancer morbidity basis.

Information of this type collected over several years and analyzed at regular intervals should prove of great value in discovering carcinogenic operations and occupations within the industries of a State or region.

#### *Industrial and Occupational Group Data*

The second survey method for the determination of occupational cancer hazards and cancer deaths utilizes the information on death causes by organizational groups of industrial workers either employed in the same type of industry, or following the same trade, or exposed to the same known or suspected occupational carcinogenic agent or agents. With this approach, it is possible to determine the relative incidence of death from cancers of various sites occurring among members of different labor unions or professional organizations, such as operating and nonoperating railroad employees, photo-engravers, steelworkers, automobile workers, rubber workers, firemen and oilers, electrical workers, hod carriers, chemical workers, machinists, asbestos workers, boilermakers, teamsters, bookbinders, and technical engineers.

The records of some labor organizations contain data on the various employments and different types of work followed by their members. Types and durations of exposure to occupational carcinogenic agents which the individual members may have sustained during their lifetime can be deduced from this information. Whenever such detailed information

on the occupational histories of union members is available, the degree of dilution of any evidence suggesting the existence of an occupational cancer hazard for the members of the organization studied is considerably reduced, and the significance of the observations made is thereby increased.

Information obtainable from death certificates from labor unions, and from records from disability insurance agencies and cancer registries also offers an opportunity to approach the epidemiology and etiology of occupational cancer from the viewpoint of exposure to the same occupational agent found in different trades and industrial organizations. Such studies are advantageous in that observations made among the members of one occupational group, if valid, should to some extent apply to other occupational groups having an identical exposure.

In this country, the Bureau of Old-Age and Survivors Insurance can provide the names and addresses of companies which manufacture or use similar products or operations in any particular State. The names and total employment histories of former employees of such companies, against whose accounts death claims have been made, can be obtained from the same source. Whenever the social security number has not been listed on the death certificate, an attempt may be made to obtain it from the informant. To verify the data furnished by the Bureau of Old-Age and Survivors Insurance and to extend them into the field of specific information as to the job or jobs held, a query should be addressed to the former employer. The cause of death can be ascertained from the death certificate. With such basic data on hand, a statistical analysis can be made to determine the incidence rate and types of cancers among members of different occupational groups having contact with the same known or suspected occupational cancerigenic agent.

#### *Previous Employment Records*

In the third method of studying occupational cancer, verified data obtained from death certificates are related to information on previous employments supplied from the records of the Bureau of Old-Age and Survivors Insurance (BOASI), Social Security Administration,

Baltimore, Md. This bureau has in its files a record of all places of employment of individuals who are covered under the Social Security Act. Since the information on employment available at this bureau includes all States in which an individual may have been employed for some time, it alleviates to a large extent the difficulty of assessing the role of all occupational factors resulting from the frequent migration of industrial labor from one State to another.

At present, the main limitation of this approach is that in many instances, especially in older workers, employment records of the insured group do not include the entire employed period of life, as the records were started only some 14 years ago (1937), and thus may not always be adequate for covering the entire known and long latent periods of occupational cancers.

The second deficiency of the employment information kept by BOASI is related to the fact that such data are recorded only for persons who are insured. They, therefore, do not apply to that part of the working population which does not fall within the Social Security Act in its original or recently amended form. However, with succeeding years, this source of information is certain to become increasingly valuable for the discovery of occupational cancer hazards, especially as the records of BOASI offer an opportunity to determine the cause of death of all deceased workers once employed in any plant or industry. Thus, attack rates of cancers with a predominantly fatal outcome can be computed from this material for the total effectively exposed worker population of an individual industrial establishment as well as of an entire industry.

Moreover, this methodological approach can be used on surveys of limited scope, such as the determination of the occupational background of cancers of specific organs. An adequate number of cases, however, must be used in such a study, and proper cognizance must be taken of the long latent periods of occupational cancers. Such investigations, undertaken on a state-wide or, perhaps even better, on a nation-wide basis in order to include any possible regional differences in the occupational or environmental cancerigenic spectrum, might yield within a relatively short time and with comparatively

moderate efforts, valuable information on the epidemiology and etiology of human cancer.

### Comments

From the foregoing discussion on the role of the State health department in the control of occupational cancer, it should have become evident that State health departments not only have an important stake in this problem but are in an especially favorable position of assessing its scope as to etiology, epidemiology, and control.

The active participation of State health departments in occupational cancer studies is most desirable since experiments in exogenous carcinogenesis, while providing valuable information, do not give results directly and unequivocally applicable to man. Observations in human carcinogenesis, therefore, are essential for definitely ascertaining the various physical, chemical, and parasitic factors in the human environment which may cause cancer in man.

In several industrialized European countries, especially England, official agencies in existence for several decades are charged with the routine study of industrial cancers. From these countries, extensive statistical data are available on the incidence, epidemiology, and etiology of occupational cancers. In contrast, there is an utter lack of similar information in the United States although our country possesses by far the largest industrial establishments. The time has come when this gap in sound public health practice should be closed, and obvious cancer hazards which affect not only certain occupational population groups but also, in part, the population in general, can be properly assessed and brought under effective control.

The various methods proposed, most of which have proved their practicability in field studies, provide State health departments with ready-made approaches to such investigations. Depending upon the organizational machinery in a particular State, and on the special occupational cancer hazards present, one or several of these methods may be found most suitable for the development of a program of occupational cancer control.

While it is possible, with the methods de-

scribed, to engage in the study of certain phases of the occupational cancer problem on a nationwide basis (determination of occupational background for specific organ cancers; prevalence of specific cancers among workers of specific industries; occurrence of cancers among different types of industrial workers and industries producing, using, or handling known or suspected carcinogenic agents), State health departments can make similar investigations more effectively

and reliably if they create adequate facilities for such work.

The rapidly increasing importance of chronic disabling diseases in public health practice applies also to cancer. Doubtlessly, the most promising approach to attain a reasonable control of this disease is through an attack on those types of cancers, the occupational cancers, of which the etiology is known or can be ascertained with available methods.

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## Field Test Study of the Membrane Filter

Under the auspices of the Standard Methods Committee for the Examination of Water and Sewage of the American Public Health Association, a field test study of the membrane filter was begun July 1, 1952. The study is co-sponsored by the American Water Works Association and the Public Health Service. It will be continued for 52 weeks.

Twelve official laboratories accepted invitations to participate in the study: department of health sanitation laboratories of California, Georgia, Indiana, Kansas, Massachusetts, New York, Texas, and West Virginia; and water works laboratories serving Detroit, Indianapolis, New York City, and St. Louis. The study is being coordinated by the Environmental Health Center, Public Health Service, Cincinnati, Ohio.

The membrane filter technique for the determination of coliform organisms and the standard five-tube, three-dilution, most-probable-number procedure will be carried out simultaneously on all water samples. As many different surface and ground water sources as possible will be examined by each laboratory. In addition to the bacteriological procedures, the following physical and chemical tests will be made: pH, alkalinity, turbidity, color, hardness, and oxygen consumed.

It is expected that information from this study will enable the Standard Methods Committee to make recommendations relative to the applicability of the membrane filter technique to the examination of water.

A previous study of the membrane filter technique was reported by Harold F. Clark et al., of the Environmental Health Center, in *Public Health Reports*, July 27, 1951.

Representatives of each of the 12 laboratories participating in the present study attended a course given April 22-25, 1952, on membrane filter procedures at the Environmental Health Center.